MOBILE COMMUNICATION SYSTEM AND COMMUNICATION METHOD FOR MOBILE COMMUNICATION SYSTEM

FIELD OF THE INVENTION

The present invention relates to a mobile station and a base station performing wireless communication, and a mobile communication system including a mobile station and a base station, and a communication method for a mobile communication system. Maria Carlos Company Contract

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BACKGROUND ARTS

As one of a communication system for the third was a communication by the communication of th generation wireless communications (standardized by ITU-T International Mobile Telecommunications-2000, or IMT-2000), the W-CDMA (Wideband Code Division Multiple Access) system has been adopted. In this W-CDMA, various techniques are introduced to improve communication quality (wireless transmission quality), which include soft handover (site diversity), site selection diversity control (SSDT), and closed-loop and 20 transmit power transmission power control.

The soft handover is a technique in which a mobile station is simultaneously connected with a plurality of base stations through wireless links, and receives signals 25 from the plurality of base stations using the RAKE receivers. At the time of the soft handover, the entire plurality of base stations performing the soft handover transmit signals

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on Dedicated Physical Channels (DPCH), and the mobile station receives the DPCH signals from the plurality of base stations.

The SSDT is a method for power control performed at the time of the soft handover, to solve a problem of increased interference on a downlink (i.e. a link directed to a mobile station from a base station) produced by the identical DPCH signals being transmitted to the mobile station from the plurality of base stations at the time of the soft handover. 10 The mobile station selects one of the base stations performing the soft handover as a primary cell, whereas we are other base stations are determined as non-primary cells and the sea Only the primary cell transmits signals on a Dedicated Physical Data Channel (DPDCH) in the DPCH, and non-primary cells do not transmit any DPDCH signals. Among the DPCH signals, Dedicated Physical Control Channel (DPCCH) signals are transmitted for the entire base stations performing the soft handover.

In the SSDT method, a mobile station measures the received signal code power (RSCP) of a Common Pilot Channel (CPICH) transmitted with constant power from each base station. The mobile station selects base stations of which measurement result is higher than the predetermined threshold as soft handover candidate. Among these soft 25 handover candidates, the mobile station selects the base station producing the maximum RSCP as primary cell. By changing (updating) the primary cell at high speed, the

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mobile station can receive the DPDCH with better reception quality.

The closed-loop transmission power control is a power control method performed in the following way: Both a mobile 5 station and a base station measure reception signal quality (i.e. transmission signal quality in terms of the transmission side). Depending on the measurement result, a transmit power control (TPC) command is transmitted to a transmission side so that a reception side can receive z . Here $z \in \mathbb{N} 0$, a signal with desired quality. The transmission side then z and zcontrols the ownstransmission power based on the TPC command* 1988 to 1989 This control method aims to solve the far-to-near problem at the solventer of the solventer and reduce an effect caused by fading fluctuation. As a measurement criterion for the receive signal quality, the SIR (signal-to-interference power ratio) is applied.

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Here, in the conventional SSDT, particularly in an expense of inner-loop control of the transmission power control on the downlink, a mobile station measures the SIR of the DPCCH received from a primary cell, compares the measurement $pprox 1000 ext{ for the 20}$ -value with a target SPR value, and generates an TPC command $pprox 1000 ext{ for the 20}$ in accordance with the comparison result. The mobile station then transmits this TPC command to both the primary cell and the non-primary cells through the uplinks (links directed to the base stations from the mobile station). According to the TPC command, the primary cell controls transmission power of the DPDCH and the DPCCH on the downlink. Meanwhile, the non-primary cells control the transmission

power of the DPCCH on the downlink, but do not control the transmission power of the DPDCH.

on the downlink at the time of the SSDT. A base station

5 selector 102 provided in a mobile station 100 measures the

RSCP of the CPICH transmitted from n base stations 2001

- 200n (where n is integer no less than 2), and selects

the base station producing the maximum RSCP value as primary

cell. The selection result of the primary cell is

transmitted to base stations 2001 - 200n on uplink feedback

information (FBI), in which identification information of

the base station indicating the primary cell is included.

Thus, each base station 2001 - 200n can identify whether

the base station of interest is the primary cell or the

15 non-primary cell.

An SIR measurement section 103 provided in mobile station 100 measures the SIR of the DPCCH transmitted from the base station which has been selected as primary cell by base station selector 102, among the DPCCH transmitted from base stations 200₁ - 200_n. SIR measurement section 103 then feeds the measurement result to a TPC bit generator 104. TPC bit generator 104 compares the measured SIR with a target SIR having been set in advance, and generates a TPC command based on the comparison result. The generated

In base stations $200_1 - 200_n$, an FBI bit extractor 204 extracts, from the received data, identification

information of the base station having been selected as primary cell. Based on this base station identification information, a switcher (SW) 203 determines whether or not the base station of interest is selected as primary cell.

- 5 If the base station of interest has been selected as primary cell, the base station concerned outputs a DPDCH data to a power controller 202, whereas if the base station concerned is not selected as primary cell, the base station concerned does not output any DPDCH data to power controller
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ways have and the Meanwhile, was TPC bit extractor 205 extracts the TPC best and it established in a command of rome the effectived data, and then feeds the TPC six recover command to power controller 202. Power controller 202 controls the transmission power of the DPCCH according to 15 the TPC command. Power controller 202 further controls the transmission power of the DPDCH in case the DPDCH data is supplied from switcher (SW) 203 according to the TPC command. These power-controlled channel data are transmitted to mobile station 100 takes the second of the s

> The power control by power controller 2020 is performed to the second using the same control method, irrespectively of whether the base station concerned is the primary cell or the non-primary cell, according to the same TPC command (that is, the same increase/decrease amount of power based on 25 the same increment/decrement). FIG. 7 shows such a conventional power control method in a tabular form. Both the primary cell and the non-primary cell increase the

transmission power by 1 dB when the TPC command indicates '1', or decrease the transmission power by 1 dB when the TPC command indicates '0'.

As such, in the conventional SSDT method, the primary 5 cell selection is performed independently of the transmission power control. Namely, the primary cell selection is determined being referenced from the RSCP of the CPICH, whereas the transmission power control is the control is the control of the control o performed by use of the TPC command determined by 10 referencing the SIR of the DPCCH. Moreover, the TPC command to be the list transmitted on each time slot bases, and therefore the broken the government transmission power control is updated at each time interval & class to a T of the time slot (for example, T = 0.667 ms). In contrast, the primary cell selection information is transmitted using 15 no less than three time slots, and therefore the primary cell is updated at time intervals three times as long as Committee to the second of the second the time interval T.

Now, according to the aforementioned method in which the primary cell selection and the transmission power 20 control are performed independently, there lies a problem that an optimal primary cell selection cannot always be guaranteed.

More specifically, although the base station transmitting the DPDCH signals with better quality has to be selected, according to the conventional method, the criteria applied for the transmission power control which effects the communication quality is different from the

criteria for the primary cell selection. As a result, there may be cases that a base station which provides better communication quality be not selected as primary cell.

Also, because the period of updating the primary cell is longer than the period of updating the transmission power control, there may be cases that updating the primary cell cannot follow the change of transmission power. As a result, a base station providing larger transmission power may not and the state of t be selected as primary cell.

the dimension of the Further, because the primary cell update periods is the ball with long, there may also be cases that updating the primary is a second preserve and cell cannot replication fading of luctuations. This may halsoned be all impede to receive the DPDCH signal transmitted from a base station providing larger transmission power.

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Also, conventionally, as having been illustrated in FIG. 7, both the primary cell and the non-primary cells perform identical transmission power control based on the common TPC command, which may possibly make it difficult to switch over from the primary cell to a non-primary cell. we can be 20 This may reduce effect of high-speed cell selections obtained by a rapid switchover of primary cell to more optimal base station.

> Moreover, because generally lower communication quality is provided by a non-primary cell than by the primary 25 cell, the transmission error rate for a TPC command may possibly be increased on the uplink also. In such a case, there arises a problem that the base station may perform

transmission power control based on an incorrect TPC command. As a result, greater transmission power difference than transmission loss difference may be produced between a plurality of base stations which are soft handover 5 candidates. This may produce increased interference among the downlinks.

To cope with this problem, a method has been proposed in the Technical Report of IEICE, RCS 2000-164, published by the IEICE (the Institute of Electronics, Information maked as 10 and Communication Engineers). According to the proposed proposed Secretary and emethody awhich a has abeen referred atomas. SIDTPC resite and a result of cindependent diversity transmit power control); a mobile transmit power control station measures the SIR of the signal from each base station. after the RAKE receiver, and generates the TPC command so 15 that each base station can perform independent transmission power control.

However, according to this method having been proposed, it becomes necessary to provide a large amount of bits in a TPC command to be transmitted in the uplink DPCCH, which which $m_1, m_2, m_3 > 20$, becomes as many as the number of base stations, case compared $m_2, m_3 > 1$ with the conventional method. Or, in order to make the number of the TPC command bits identical to the conventional method, the transmission power control period becomes longer, which may deteriorate capability to follow fading fluctuations.

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DISCLOSURE OF THE INVENTION Considering the above-mentioned background, it is a first object of the present invention to enable selection of a base station which transmits a user data signal with better quality, in a communication condition such that the user data signal is transmitted with power control from one base station selected from among a plurality of base stations by a mobile station.

It is a second object of the present invention to enable updating (switching) from the selected base station at high speed.

regressions 10 to see In order to attain the above-mentioned first object, we see an ex-

twin (which according to a first aspect of the present invention; a value to a y we same the mobile station chaseradio channels being set between a the early agenmobile station and a plurality of base stations, and performs communication with the plurality of base stations, 15 in a communication condition such that one base station selected among the plurality of base stations transmits a user data signal which transmission power is controlled, and that the plurality of base stations including the selected base station transmit signals including a control makewar 20 data signal which transmission power is controlled incapacities to similar way as the user data signal. The mobile station includes: a measurement section measuring, on a basis of each base station, quality of the control data signal transmitted with the transmission power controlled; a 25 selector selecting the base station transmitting the user data signal, based on the quality of the control data signal from each base station measured in the measurement section;

and a transmitter transmitting identification information for identifying the base station selected by the selector, to the plurality of base stations.

In regard to the above-mentioned quality measurement, signal-to-interference power ratio is used in embodiment of the present invention, or reception power is used in another embodiment.

According to the first aspect of the present invention; the transmission of the user data signal from the base we shall be 10 station with transmission power controlled is performed by the war which make the based on the quality of the control datastransmitteds with a some base ascribes that the transmission power controlled in assimilar waynas they bear to user data signal. Therefore, as for the transmission of the user data signal, it becomes possible to select the 15 base station which can transmit user data signal with the best quality, and accordingly, the mobile station canreceive this user data signal with the best quality.

Preferably, the mobile station further includes a \cdot \cdot \cdot \cdot generator which has preset target quality and compares the \cdot \cdot \cdot \cdot \cdot ~ 20 -target quality with the quality of the base-station selected ~ 100 by the selector among the quality sets measured by the measurement section, generating power control information instructing to decrease the transmission power in case of the latter having better quality than the former, and instructing to increase the transmission power in case of the former having better quality than the latter.

In this way, the selection of the base station

transmitting the user data signal and the generation of the power control information are performed based on the quality of the identical control data signal. Namely, the criterion for the base station selection and the criterion 5 for the power control information determination are commonized (unified).

Preferably, the mobile station further includes a walking of enerator generating power control information indicating was the control information and cating was the how the transmission power of the plurality of base stations $\sim 10^{10} M_\odot$ is to be controlled, based on the quality of the base station which we have selected by the selector among the quality sets measured was a sign week was the measurement section. The transmitter stores the think is power control information generated by the generator, as well as the identification information, into each time slot 15 in a frame having a plurality of time slots, and transmits the power control information and the identification information to the plurality of base stations.

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In this way, the identification information of the was the base station transmitting the user data signal discussion of $m_{i} \approx m_{i} \cos 20$, transmitted sin reach time shot . Therefore q_{i} by cuse cos cos cos cos <math>cos costime slot data, it becomes possible to select the base station transmitting the user data signal. Thus, it becomes possible to select the base station (updating, or substitution, of the base station) more rapidly than in the conventional method, and the aforementioned second object of the present invention can be achieved. As a result, it becomes possible to make the base station selection

follow fading variations.

According to a second aspect of the present invention, a base station has radio channels being set between the base station and a mobile station, and transmits a user 5 data signal which transmission power is controlled to the mobile station only when the base station of interest is selected by the mobile station, and also transmits, to the which transmission power is controlled in a similar way deliver had 10 a as the suser data signal, irrespective of whether coranot and a was series as the mobile station of interest is selected. The base station has passed resolution includes: a meceiver receiving identification information is solve our transmitted from the mobile station, representing the base station which is selected by the mobile station based on 15 the quality of the control data signal transmitted with the transmission power controlled; and a transmitter transmitting the user data signal to the mobile station only when the identification information represents the * 2000年度、大学、大学会会、大学、学生、学生、企業 base station of interest.

According to the second aspect of the present invention, a communication method for a base station is disclosed.

The communication method is performed in each plurality of base stations, in a communication condition such that radio channels are set between the plurality of base stations and a mobile station, that a user data signal is transmitted which transmission power is controlled to the mobile station from one base station selected among the

plurality of base stations, and that control data signals, which transmission power is controlled in a similar way as the user data signal, are transmitted to the mobile station from the plurality of base stations including the selected base station. The communication method includes: receiving identification information, transmitted from the mobile station, representing the base station which The state of the selected by the mobile station based on the quality of the state of the control data signal with the transmission power: and when the 10 controlled; wand when the identification information and has a subservable and a represents the base station of interest; stransmitting the set as well as formed in the user datassignal with the transmission power controlled particle to a and also transmitting the control data signal with the transmission power controlled, whereas when the 15 identification information does not represent the base m_{ij} is m_{ij} m_{ij} station of interest, transmitting the control data signal m_{ij} m_{ij} transmission power controlled, without with transmitting the user data.

According to a second aspect of the present invention, corrections 20 ithe base station itransmitting the correction data is ignally is correction correctionselected by the mobile station, based on the control data signal with the transmission power controlled similar to that performed against the user data signal. Thus, it becomes possible to select the base station capable of 25 transmitting the user data signal with the best quality, and the mobile station can receive the user data with the best quality.

Preferably, each of the base stations further receives in the receiver the power control information determined by the mobile station based on the quality of the control data signal, indicating how the transmission power is to 5 be controlled. The base station further includes a power controller which controls transmission power of both the user data signal and the control data signal, based on the power control information received by the receiver.

In this way, similarly to the first aspect, both the dividual results selection of the base station transmitting the user data systems the the claim to signal and the generation of the power control information which the for the power control sofithe base station are performed book likely based on the same control data signal quality, and thus the criterions are commonized (unified) in the first of which is a common of the criterion of the common of the criterion of

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Further, preferably, the identification information of the base station transmitting the user data signal is received in each time slot of a frame having a plurality of timing sets. Thus, it becomes possible to select the base station transmitting the user data signal in each time where ~ 2.020 is lot. This enables faster-base station selections (update such that of the base station) than in the conventional method. As a result, updating the base station becomes easier to follow fading fluctuations than in the conventional method.

> In the second aspect of the present invention, according to a first preferred embodiment, when the identification information represents the base station of interest, the power controller controls to increase the

power in case of the power control information instructing increase of power, and to decrease the power in case of the power control information instructing decrease of power, whereas when the identification information does not 5 represent the base station of interest, the power controller controls to increase the power in case of the The state of power control information instructing increase of power; we have and maintains the present power in case of the power control information instructing decrease of power. We have the contractions and the contraction of the contraction o

name and 10 miles in According to massecond preferred embodiment, when the adversarior

was visited the description information represents the base station of the base station of were the same that interest, athe spower scontrollers controls at on increase athe same and power in case of the power control information instructing increase of power, and to decrease the power in case of 15 the power control information instructing decrease of power, A second the whereas when the identification information does not an represent the base station of interest, in case of the power control information instructing increase of power, the power controller controls to increase the power with a services 20. smaller wincrement with an enthe wincrement woff when so the corresponding identification information represents the base station of interest, and in case of the power control information instructing decrease of power, the power controller controls to decrease the power with a smaller decrement 25 than the decrement of when the identification information represents the base station of interest.

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According to a third preferred embodiment, when the

identification information represents the base station of interest, the power controller controls to increase the power in case of the power control information instructing increase of power, and to decrease the power in case of 5 the power control information instructing decrease of power, whereas when the identification information does not represent the base station of interest, the power controller controls to maintain the present power in case of the power control information instructing either

weakened to the Asesuch, caccording to these preferred embodiments, we have been begges, which is it is set? to perform different power, control abetween aim at lareace. the base station selected by the mobile station and in the the selected. Therefore, with becomes to the selected. Therefore, with becomes to the selected of the selected 15 unnecessary for the mobile station to generate and transmit individual power control information for each base station. This enables reduction of power control information field in each time slot.

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Also, with regard to the transmission power control makes the 20% method based on the power control information; the method with the best employed for the base station selected by the mobile station differs from the method for other base stations not selected. Accordingly, the transmission power control results in higher probability of any base station not selected 25 becoming substituted for the base station having been selected. In other words, updating the base station selection is promoted. Moreover, even when incorrect power

control information is transmitted due to an uplink transmission failure, the transmission power difference between the base station selected and the base stations not selected can be prevented from extending more than the degree of transmission loss difference. As a result, increase of the interference on the downlink can be avoided.

According to a third aspect, in a mobile communication

system having a plurality of base stations and a mobile of the stations and a mobile of the stations and the stations are stations.

station, with radio channels being set between the eta , which is 10 -plurality of base stations and the mobile station, in which we write Taktoring to a user data signal disstransmitted with transmission power of the transmission power of the transmission of the contract of the c warrand the solution troubled to the emobile station from Lone base station & lace the selected among the plurality of base stations, and control when the data signals, which transmission power is controlled introduced 15 a similar way as the user data signal, are transmitted to the mobile station from the plurality of base stations including the selected base station, the mobile station includes: a measurement section measuring quality of each control data signal on a basis of each base station; a was the 20% selector selecting the base station transmitting the user was a constant data signal, based on the quality of the control data signal from each base station measured in the measurement section; and a transmitter transmitting identification information for identifying the base station selected by the selector 25 to the plurality of base stations. Each plurality of base stations includes a transmitter transmitting the user data signal to the mobile station only when the identification

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information transmitted from the mobile station represents the base station of interest.

According to the third aspect, in a communication method for a base station among a plurality of base stations, 5 with radio channels being set between the plurality of base stations and a mobile station, performed in a communication condition such that a user data signal which transmission • ** ** ** power is controlled is transmitted to the mobile/station ** ** from one base station selected among the plurality of base approximately distations; and that control data signals, which transmission was a second and the second sec the management power is controlled in a similar way as the user datassignal, a minor the is of the bath of are transmitted to the mobile station from the plurality of the mobile. entable with of base stations including the selected base station, which and the mobile station: measures quality of the control data and the 15 signals on a basis of each base station; selects the base was already extation transmitting the user data signal, based on the constant measured quality of each control data signal transmitted from each base station; and transmits identification information for identifying the selected base station, to real logorous 20 of the plurality of basetstations wand each plurality of base 48.40 or 40.4 stations: when the identification information transmitted from the mobile station represents the base station of interest, transmits the user data signal which transmission power is controlled based on the power control information to the mobile station, and also transmits the control data signal with the transmission power controlled, whereas when the identification information does not represent the base

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station of interest, transmits the control data signal with the transmission power controlled, without transmitting the user data.

According to this third aspect, it is possible to obtain the same functions and effects as in the first and second aspects of the present invention.

According to another aspect, a mobile station of the

ware the course performing communication with a plurality of base stations which is measuring, on a basis of the section measuring, on a basis of the section measuring, rangeous and Oraceach, basel station, requality of control data ssignals, which has no great respondence a large transmitted of from the plurality wof abase distations we have warm is also raddressed to a the ambile a station of dinterest land which while what transmission power is controlled; a selector selecting a from the trade of base stationstransmitting a user data signal addressed atomic as as or 15 the mobile station of interest, based on the quality of the control data signals which are addressed to the mobile station of interest and measured in the measurement section; and a transmitter transmitting identification information for identifying the base station selected by

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Further, according to still another aspect of the present invention, a base station performing communication with a mobile station includes: a receiver receiving identification information transmitted from the mobile 25 station, representing the base station which is selected based on quality of control data signals which transmission is controlled; and a transmitter when power the

identification information represents the base station of interest, transmitting with the transmission power controlled, both a user data signal addressed to the mobile station and the control data signal addressed to the mobile 5 station, whereas when the identification information does not represent the base station of interest, transmitting the control data signal addressed to the mobile station with the transmission power controlled, without transmitting any user data addressed to the mobile station

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Drawman, no convers Still of urther, waccording to another daspect conditine of the continue of the continue of ad annimal appresents invention; whim a mobile communication asystem to a said performing communication between a plurality of base representations and a mobile station, the mobile station in measures that it 15 quality of control data signals, which are transmitted with the transmission power controlled from the plurality of base stations and addressed to the mobile station of interest, on a basis of each base station; selects the base 20 mobile station of interest, based on the measured quality of the control data signals which are transmitted from the plurality of base stations and addressed to the mobile station of interest; and transmits identification information for identifying the selected base station, to the plurality of base stations. The base station: when the identification information transmitted from the mobile station represents the base station of interest, transmits

with the transmission power controlled, both the user data signal addressed to the mobile station and the control data signal addressed to the mobile station of interest, whereas when the identification information does not represent the base station of interest, transmits the control data signal addressed to the mobile station of interest with the transmission power controlled, without transmitting any user data addressed to the mobile station of interest.

Further scopes and features of the present invention of the present inv

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a block diagram illustrating apportion of the mobile communication system according to an according to

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FIG. 2A shows a frame format of an uplink DPCH (DPDCH and DPCCH).

FIG. 2B shows another frame format of an uplink DPCCH. Section 400

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FIG. 4A shows a power control method according to an embodiment of the present invention.

FIG. 4B shows another power control method illustrated in a tabular form.

25 FIG. 4C shows still another power control method illustrated in a tabular form.

FIG. 5 shows a block diagram illustrating a portion

of a mobile communication system according to another embodiment of the present invention.

FIG. 6 shows an aspect of transmission power control for the downlink in case of the conventional SSDT.

FIG. 7 shows the conventional power control method illustrated in a tabular form.

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The preferred embodiment of the present invention is and present invention is and present invention is not limited to the embodiments of the present invention is not limited to the present invention is not limited to the embodiments described below.

of the mobile communication system according to one embodiment of the present invention. This mobile communication system, as an example, employs W-CDMA (Wideband-Code Division Multiple Access), the communication standard of the third generation wireless communications (IMT-2000). The mobile communication system is provided with a mobile station 1, n base stations (where, n is an integer no less than 2) 2, - 2, and a radio network control unit (base station control unit) 3.

Mobile station 1 is exemplified by portable telephone, automobile telephone, and personal digital assistance, which perform radio communication with the entire base.

stations 2₁ - 2_n, or a portion thereof, using the Code
Division Multiple Access (CDMA). This mobile station 1 is
provided with a receiver 11, m SIR measurement sections
12₁ - 12_m (where, m is an integer no less than 2), a base
5 station selector 13, a switcher (SW) 14, a TPC bit generator
15, a transmitter 16, and antennas 17, 18.

Antenna 17 receives downlink signals (data) transmitted from base stations 2₁ - 2_n (hereafter each base station 2₁ - 2_n is generically referred to as base stations from the station 2₁ - 2_n is generically referred to as base stations from the station 2₁ - 2_n is generically referred to as base stations from the station 2_n except for other cases, particularly necessary at the supplies distinguish) using 2 GHz-band radio waves. Antenna 17 then supplies supplies the specieved data to receiver 11s. Antenna 18st transmits uplink data supplied from transmitter 16 to base 1 transmits uplink data supplied from transmitter 18 tr

on the downward direction (downlink) include Dedicated

Physical Channel (DPCH), Common Pilot Channel (CP4CH), etc.

20 The physical channels for the signals on the upward direction (uplink) include Dedicated Physical Channel (DPCH), Physical Random Access Channel (PRACH), etc.

The physical channels for the signals to be transmitted at the signals are the signals and the signal are the signal signal and the signal are the signal ar

Each channel includes frames (radio frames) each having a plurality of time slots, and communication data are conveyed in these time slots. Each frame has a length of, for example, 10 ms, in which 15 time slots are included.

Both the uplink DPCH and the downlink DPCH are

individually assigned for each mobile station, and have Dedicated Physical Data Channel (DPDCH) and Dedicated Physical Control Channel (DPCCH).

One or more DPDCH are assigned for mobile station 1

by which uses the DPCH, for use in conveying user data (voice data, character data, image data, etc.) of a user who uses mobile station 1. Meanwhile, one DPCCH is assigned for assigned for assigned for assigned physical-layer control data in the DPCH. In the downlink, as a second to the DPCH and the DPCCH are time-multiplexed within one as a second to the DPCH and the DPCCH are time-multiplexed within one as a second to the DPCCH and the uplink, the DPCCH and the DPCCH are time-multiplexed.

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instrument with are I/Q-multiplexed on bastrame-by-frame basis: spensed out or fine.

FIG. 2A shows the frame structure of the uplinksDPCH (DPDCH and DPCCH). As described earlier, each radio frame has a plurality of time slots (15 time slots, TS). Each time slot includes I/Q-multiplexed data of the DPDCH and the DPCCH.

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The DPDCH includes user data, as described earlier.

The DPCCH includes a pilot bit of a known pattern used for channel estimation in the pilot symbol aided coherent

detection, a transport format combination indicator (TFCI), a transmit power control (TPC) bit (or TPC command) of base station 2, and feedback information (FBI).

One bit is assigned for the TPC bit. In this TPC bit,

is to be increased, while '0' is set when the transmission power of base station 2 is to be decreased.

power of base station 2 is to be decreased.

Further, according to the embodiment, fast cells selection (FCS) bits (or FCS command) are included in the FBI field shown in FIG. 2A, or accommodated in an FCS field, as shown in FIG. 2B, when the FCS field is provided separately and the rom the FBI field in the time slot (for example, as in the case of the extended 3GPP specification; the 3rd and 18

The FCS bits represent identification information indicating primary cell 2 selected at the time of the SSDT.

As this identification information, for example, a temporary cell ID assigned for each base station 2 at the time of the SSDT is used. Namely, the base station having the temporary cell ID represented by the FCS bits is the primary cell, and other base stations are the non-primary cells.

. If i=15 , i=15 . Generation Partnership Projects.) The state of the constant i=15 . We have i=15 . We have i=15 .

FIG. 3 shows the frame structure of the downlink DPCH.

5 Similarly to the uplink DPCH, the downlink DPCH radio frame includes a plurality of time slots (15 time slots, TS).

In each time slot of the downlink DPCH, the DPDCH and

the DPCCH are time-multiplexed, as described before. The DPCCH includes TPC bit, TFCI, and pilot bit for mobile station 1.

Now, receiver 11 performs amplification, de-spreading,

5 RAKE combining, frequency conversion, A/D conversion, etc.

against the signals received by antenna 17. Receiver 11

supplies the DPDCH data included in the reception signal

to a data processor, and supplies the DPCCH data to SIR

measurement sections 12, - 12,

Data processor performs predetermined process against a company the DPDCH data, and thereafter outputs voice data included a second of the data to a speaker etc. (not shown), and displays for a character data, image data, etc. included in the data onto a display unit (not shown) such as a liquid crystal displays a character data.

The reception signal of the DPCCH is Rake-combined

by receiver 11 on a basis of each base station 2, and some station 2, and some station 2. The demultiplexed into the DPCCH data of each base station

thereafter demultiplexed DPCCH data of each base station

2 is supplied to each SIR measurement sections 12; - 12ms (12ms)

For example, the DPCCH of base station 2; is supplied to some station 3; is supplied to some stati

is supplied to SIR measurement section 122, and so on.

The above value m is set equal to the number of base stations 2 to be selected as candidate for soft handover, i.e. the number of the active sets. Therefore, in ordinary cases, m is set smaller than n (m < n). Further, even on receipt of signals from more than m base stations 2, receiver

11 selects the radio waves received from m base stations 2. Thereafter receiver 11 performs RAKE combining against the signals received from each base station 2, and supplies the Rake-combined signals to SIR measurement sections 12, $5 - 12_{m}$.

Here, the active sets are updated periodically, as s that s -alone s mobile station 1 moves s Also, when one cell is divided into s as s -sformality of sectors, each divided sector is assigned as a sector with the first as active set. The war product of the weather the many of the second of

satisfies 0.00 to the SIR: measurement essections 0.12_{10} = 0.12_{m} in (hereafter the constant) residence the configuration of the section of the s the parameter of the contract particular) measure an SIR (signal-to-interference powers Classical Company) timp hugu. It ratio) of the received DPCCH data corresponding to seach at MARING. to account 15% base station 2 on actime slot basis, and supplies the SIR, and account Proceedings measurements value for each time slot atombase estation of some the state of a selector (13) and switchers 14.5 m and a spector of the production of

Base station selector 13 determines the maximum value to two actions of the SIR by: comparing m SIR data supplied from SIR into the 1 with 1 , 20 1 measurement as ection 2 1 . (Base 4 station as electors 1 3 , then 2 1 2 1 2 2selects base station 2 corresponding to the maximum SIR value as primary cell. Thereafter, base station selector 13 supplies identification information representing the selected primary cell (for example, temporary cell ID) as the FCS bits to switcher 14 and transmitter 16.

> Here, the identification information assigned to each base station 2, for example the temporary ID, is notified

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in advance both to base station 2 and mobile station 1 from radio network control unit 3. In addition, when there are two or more base stations 2 producing the identical maximum SIR value, any arbitrary one of base stations 2 is selected as primary cell. Base stations 2 other than primary cell 2 become non-primary cells.

place to the FCS bits supplied by base station and was

of reference selector 13; switcher 14 sets the own switch condition so the second that the SIR of primary cell 2 indicated by the FCS bits a money would is noutput to TPC bit generator 15. Thus withe maximum oSIR passes as or in the control of rgafilmed maderical in IncIncibitagenerator:15, a a target SIR determinedabyatkur ita, ${\mathbb R}_{n,n-1}$ is a sum of ${f n}$ non-illustrated outer-loop transmission power control is ${f n}$ for ${f n}$ ${f n}$ ari for average set in advancer: TRCabit generator 15/compares/the maximum:////aaaaaaaa $_{
m color}$ ~ 15 SIR value supplied from switcher 14 with the preset target ~ 100 $^{\circ}$ m with m SIR. When the maximum SIR value is greater than the target $\mathbb{R}[1]$ with \mathbb{R} The state of SIR, TPC bit generator 15 outputs to transmitter 160thers to the TPC bit '0' (DOWN bit), which is an instruction to decrease or a representation of the transmission power. Whenethe maximum SIR evalue piscent a vertex $color \sim 20$ color maller than the target SIR; TPC bit generator <math>25 $coutputs <math>\sim 8$ $color \sim 20$ to transmitter 16 the TPC bit '1' (UP bit), which is an instruction to increase the transmission power. When the maximum SIR equals to the target SIR, whichever instruction of increasing or decreasing the transmission power is applicable. One of the instructions is set in advance in TPC bit generator 15.

The DPDCH data supplied from the data processor, as

well as data related to other channels (not shown), is input to transmitter 16, in addition to the FCS bits supplied from base station selector 13 and the TPC bit supplied from TPC bit generator 15. The DPDCH data includes voice data input by the user from a microphone (not shown), image data input from an imaging device such as a CCD camera, and the like. THE CARLOS OF A COMMENT OF THE COMMENT OF STREET

with the least a . Transmitter f 16 performs processing against otherwise imputes a and asuch as frequency conversion, spreading, aD/Access of data, respond 10 conversion, Corthogonal modulation, coandmamplification and results where make a Transmitter: 16 then transmits the processed data (to bbase so as a large transmit) tado begain de en comestation de creira antienna e 18 de come de la come come come come de come come come come

The TPC bit and the FCS bits are transmitted on the Law 1920 of to transitions to a DPCCH as shown pint FIGS: 2A, 2B explained tear lier. Little At the Little

The TPC bit consisting of one bit is included in each and a second from normalist time slot inconesframe (for example, each: time: slot: in: 15: 4: 0: 0: 0: 0: 0: 0: 0: 0: 0: 0: and a finish time slots). Busing this TPC bit transmitted in each time in 1920 or slot, base station 2 can perform transmission power control, was well as will be described later. For example, in case what one will be yet www.com. 20% frame lengthm/insterms of stime)wis 10 ms, mand one frame a same of includes 15 time slots (i.e. 1 time slot = 0.667 ms), the transmission power control is performed at the rate of 1,500 times per second.

> Also, as for the FCS bits, the entire bits are included 25 in each time slot in one frame. Namely, in one time slot, the FCS bits necessary for identifying each of m base stations 2 of active sets are included. For example, when

m = 8, the FCS bits of at least 3 bits are included in one
time slot. Thus, using the FCS bits included in one time
slot, each base station 2 can determine whether the base
station concerned is selected as primary cell. As a result,

5 the primary cell is updated at the same intervals as the analysis power control is performed using the TPC bit (for example and the analysis of the selection of the selection

Figure 1 was the widentical passion 21 - 2n has the widentical passion but it was between the configuration, wincluding transmitter 24 appower control lensing transmitter 24

المَّانِينَ عَلَيْهِ اللهِ العَلَمِينِ العَلَمِينِ Antenna 28 receives uplink signals (data) transmitted المَّ

and supplies the received data to a receiver 26. Antenna and a receiver 26. Antenna and a receiver 26. Antenna and a receiver 27. Transmits adownlink signals (data), supplied of from a receiver 21 to mobile station 1, also using the 2 GHz-band and receiver 21 to mobile station 2, 28 may otherwise be combined into a single antennas 27, 28 may otherwise be combined use.

Receiver 26 performs the same processing against the reception data as receiver 11 in mobile station 1 described earlier. Receiver 26 then supplies the received DPDCH data to radio network control unit 3, and also supplies the received DPCCH data to TPC bit extractor 25 and FCS bit extractor 24.

Radio network control unit 3 transmits the received

DPDCH data to the base station 2 concerned, or another base station 2, or a non-illustrated core network. reception data is finally transmitted to another mobile station, or a server, terminal, etc. in another 5 communication network (for example, the Internet)

TPC bit extractor 25 extracts the TPC bit from each and a second time slot of the DPCCH, and supplies the extracted TPC bit is the same and to power controller 22. FCS bit extractor 24 extracts the s skylwyr or FCS bits fromdeach time slot of the DPCCH, and supplies were a total times killer all on the extracted FCS; bits to switcher; 23; and power control:lers from what is

ossen and announce **22 s** completion 没有,确实的现在分词,也可以说了一个点法,一个可以说了,说话,你是一个好好,这么说话,这个

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The transmission data of the DPDCH supplied: from madio data of the DPDCH supplied: from madio data as fall network control unit. 3 is input to switcher 23, in addition. her believe a tableas for ey to the: FCS:bits: supplied of romaFCS. bit vextractors.24.2 copyed or of a cover

Switcher 23 determines whether the FCS bits supplied and a second from FCS bit extractor 24 are identification information More than the second of the base station concerned. Switcher 23 sets and in the the own setting conditions depending on the above emposees to a determination result, has described in the following:: Till and the f to the identification information represented by the FCS bits are to a contract the second se specify the base station concerned (in other words, if the base station concerned has been selected as primary cell), switcher 23 supplies the DPDCH transmission data to power controller 22. On the other hand, if the identification information represented by the FCS bits does not specify the base station concerned (in other words, if the base station concerned is a non-primary cell), switcher 23 does

not supply the DPDCH transmission data to power controller 22. With these settings, the SSDT is performed, and the DPDCH transmission data is transmitted from the primary cell only, and not transmitted from any non-primary cells.

Because the FCS bits are supplied to switcher 23 at en an array each stime slot of the DPCCH, then above-mentioned are sen which will be addedormination, whether the base stations concerned is the constituted construction of primary of cell, whand do the disetting whether wither DPDCH was a book and the transmission data is to be supplied to power controller as well as http://www.nc.10 22.are.performedwate the intervalseofathe time/skotse/cforwe-kabe-e strong and the example, 0.667 ms or 1,500 times perspected). (In/such angle 0) where we do not way, updating of the primary cell is performed at the time was to co . Note: The large of slot intervals. The same will be an expected by the large will be a controlled by the control of the cont

tribulating of transmission data with pregardato the plumality of mobilied to take t stations are input to switcher 23. At the same time, the world since FCS bits and the TPC bit in the DPCCH are transmitted from excess the plurality of mobile stations. In this case, switcher (*) no new total $8.66 imes 6.20^\circ$ (2.3) sets:whether or not the DPDCH transmission-data-forceach (6.6)mobile station is to be supplied to power controller 22, based on the FCS bits from each mobile station. For example, when a mobile station A selects base station 2_1 as primary cell, whereas a mobile station B does not select base station 2_1 as primary cell, switcher 23 in base station 2_1 supplies the DPDCH transmission data for the mobile station A to

ration, regarding of more when there are laupturality of mobile stations which principle is

aggreence 15 are communicating with one base station 32, withe DRDCH and the communicating with one base station 32, with a DRDCH and the communication of t

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25

power controller 22, whereas switcher 23 does not supply

the DPDCH transmission data for the base station B to power controller 22.

The DPCCH transmission data is also input to power controller 22 of base station 2 from radio network control

5 unit 3, in addition to the TPC bit supplied from TPC bit extractor

6 extractor 25, the FCS bits supplied from FCS bit extractor

7 24, and the DPDCH transmission data supplied from switchers

7 25 26 27 28 when the base station concerned is selected as primary and cell.

Same and the TPC bitternput; power above the FCSabits and the TPC bitternput; power above the base of the base of

FIG. 4A shows a power control method according to the present invention in a tabulart form. Power control according to the according to the power can be according to the accord

When the TPC bit is '1', power controller 22 in primary cell 2 increases the transmission power of both the DPDCH and the DPCCH by 1 dB, whereas when the TPC bit is '0', power controller 22 decreases the transmission power of both the DPDCH and the DPCCH by 1 dB.

On the other hand, in non-primary cell 2, switcher 23 inhibits to input the DPDCH data to power controller

22. Accordingly, power controller 22 in base station 2 of non-primary cell does not perform the transmission power control for the DPDCH (power control is set Off). Meanwhile, power controller 22 in non-primary cell 2 performs 5 transmission power control for the DPCCH in the following Additional to the TPC bit is 11', power controller 22' Fig. 4. A Sec. 1. increases the DPCCH transmission powertby of idB. wWhen the wave mask. TPC bit is 10%, power controller 22 neither increases nor controller. decreases the DPCCH transmission powers (that wis, the angle of the continued of the contin ない アンプログログ increase/decrease amount ris. 土 0 (dB) and かりまたがならにあるとう かんばならい アンバリ

Conditionally as for the transmission power, antupper routure to and a limitais setwin advance in power controller 22 a When the assaur app of the latter power value is to exceed the upper limit; power controller and take any I where will 22 does not increase the power, despite the TPC bit of the by rea

The transmission data of the DPCCH and the DPDCH, to seem the control of the cont the which the above-mentioned power control has been performed policy of the to brown the control supplied itor transmitter/21: to some broady his cities in group base of

To transmitter 21, in addition to the DPCCH data (and er explaint from the DPDCH data) padata related to other channels (chot shown)), except exclusive 20 are supplied. Transmitter 21 performs the same processing which it is as for mobile station 1 described earlier against these channel data, and transmits these channel data via antenna 27.

As such, inner-loop power control is performed in a 25 closed loop formed of receiver 11, SIR measurement section 12, switcher 14, TPC bit generator 15, and transmitter 16 in mobile station 1, and also in a closed loop formed of

receiver 26, TPC bit extractor 25, power controller 22 and transmitter 21 in base station 2.

According to the embodiment of the present invention,
transmission power control is performed in a different
manner between in the primary cell and in the non-primary
cell, against the common TPC bit. Accordingly, it is not a second in the primary cell and in the non-primary
mecessary to generate and transmit different TPC bits to assert the common transmit different TPC bits field can be a second transmit be reduced in size.

Further, in non-primary cell 2, the transmission powerolagous as a second secon

Further, even when an incorrect TPC bit is transmitted due to a transmission failure in the uplink, the transmission power difference between the primary cell and the non-primary cell can be prevented from extending more than the degree of transmission loss difference. As a result, increase of the interference on the downlink can be avoided. For example, even when an incorrect TPC bit of '0' is

transmitted to the non-primary cell due to a transmission failure, despite the correct value '1', the transmission power of the non-primary cell is not decreased. Accordingly, it becomes possible to avoid an excessively large amount of variation in the transmission power difference produced between the primary cell and the non-primary cell.

Moreover, according to the embodiment of the present.

invention, the selection of primary cell 2 is performed.

based on the SIR, which is one of reception characteristics.

base station 2 having the maximum SIR value is selected.

as primary cells There is a correlation between whether the SIR of the DPCCH is large (that is, whether the communication quality is good) and whether the SIR of the similar power control is performed,

is large. Therefore, primary cell 2 having been selected.

based on the SIR of the DPCCH is to provide good communication quality of the DPCCH. Thus, on the occurrence of the SSDT,

it becomes possible for mobile station of to receive the series.

20 DPDCH from they base stations which provides good.

Further, according to the embodiment, selection of the primary cell 2 is performed at the time slot intervals.

Accordingly, updating of primary cell 2 is performed more rapidly than that performed in the conventional method. It becomes possible to follow fading variations at higher speed than before. Even when the fading varies abruptly,

the Charmet of communication quality. The first of the second section of the second second second second second

updating the primary cell at high speed makes it possible to avoid a bad influence to the communication quality.

in a tabular form. The transmission power control in base

5 station 2 acting as non-primary cell is different from the

power control method shown in FIG. 44A, athough ather

transmission power control in base station 2 selected as

primary cell is identical. Namely, the DPCCH transmission power power in non-primary cell 2 is increased by 0.45 dB when the station are substantial. The TPC bit is 11 (parand is decreased by 0.55 dB when the station are substantial.)

extent in the primary cell than in the non-primary cell, and in case of decreasing the transmission power. This can also and the primary cell. Moreover, even when an incorrect TPC bit is transmitted due to an analysis uplinks transmission failure, the transmission power difference between the primary cell and the non-primary cell can be prevented from extending more than the degree and interference increase on the downlink can be avoided.

inglanting control of the third methody atherpowers is decreased at on an greatern has a power.

FIG. 4C shows still another power control method illustrated in a tabular form. According to this method, when base station 2 is a non-primary cell, the DPCCH transmission power is controlled to be invariable, irrespective of the TPC bit of '1' or '0'.

With this method also, the power is decreased to a

greater extent in the primary cell than in the non-primary cell, in case of decreasing the transmission power. This can also promote easier substitution of the primary cell. Moreover, even when an incorrect TPC bit is transmitted 5 due to an uplink transmission failure, the transmission to the street of power difference between the primary cellmand the street research the common primary cell-cambe prevented from extending more than the the common telliness of nowing the control of with the constant of the contraction of the contrac with the ${f x}{f 1}{f 0}$, we will assume the reembodiment of the present invention, mobile ${f x}{f 0}$, we will station 1 selects apprimary cell by comparing the DPCCH select to applications of a spower, the continue of the december of the percentage of the perc diagram illustrating a portion of the mobile communication and the communication of the mobile communication and the communication of t

en manager of a identical symbols are assigned to configuration elements we have identical to those shown in FIG. 1, and detailed description e where the end of these configuration relements is omitted. In the mobile of sales as $\omega m \in \mathbb{R}^{20}$. Communication system shown in FIG2-5, whifteently from that $\omega \omega \omega v$ are shown in FIG. 1, the SIR measurement sections $12_1 - 12_m$ in mobile station 1 in FIG. 1 is replaced by power measurement sections $19_1 - 19_m$ in FIG. 5, so as to measure the DPCCH reception power (RSCP: received signal code power) received in receiver 11.

manual grown and an according to both is calternative embodimentiof the base of the

means were really as In the mobile communication system shown wind FIG: 650 as the communication

proceedings 15 present invention. A substitution of the second of the se

With this configuration, a base station selector 20 determines the maximum power value among m power values

25

measured in power measurement sections $19_1 - 19_m$, and outputs as the FCS bits the identification information of base station 2 corresponding to the maximum power value. Also, a TPC bit generator 30 compares the target power value having . 5 been set in advance by a non-illustrated outer-loop The second transmission power control, with the maximum power swalue as keep was a small resched by switcher 14. A TPC bit '0/listoutput when the 14. Here's reforms by learning maximum power value is greater than the target power value per section : associates in the whereas a TPC bit of this coutput when the maximum power avalue is carefully a The WARCHE Elements in both mobile stations I and base stations 2 mare her security ether beaker e similar (toxthose, shown eint ElGeb.1 . There a . Activatives, exeme else the what who have provided With this whalternative be sembodiment; in high-speed in a which the at and refer to selection coff camprimary acell chaving agood communications y band is and the state of t and the communication asystem shown in a FIG. of the man attached by the complete and the communication asystem and the communication as the communication of the communication and the communication as the communication having been illustrated, the reception characteristic of emorphism is the DPCCH is measured. However, it may also be possible and moved a $\sim 100 pc^{2}$ which is measure the preception characteristics (theosity otherwise which reception power RSCP, etc.) of other channels on which the transmission power control is performed in a similar way

Further, in the foregoing description of the 25 embodiment, W-CDMA is applied as prerequisite. However, the present invention is not limited to the W-CDMA system. The present invention may also be applicable for the Code

to the DPDCH.

Division Multiple Access (CDMA) systems as a whole, including the multi-carrier CDMA. Also, it is possible to apply the present invention to other communication systems, such as the Orthogonal Frequency Division Multiplex (OFDM) 5 employed as transmission technique for ground-wave digital twinterwater in the broadcasting. This we have not been also been also been also been also been also been also

WELL-WEST SEED TO CONTROL OF THE OWN INDUSTRIAL APPLICABILITY CONTROL OF THE SEMISTIME REPORT OF

works to accept the open entrainvention can be applied for wax mobile and be as

the programment of the contraction of the contracti

a time to m time to the communication system; was well has a mobile station (portable to a service / A was well seems to telephone, caratelephone, PDA, retc.) Mandrasbasesstations of 1936 Janua . . Thanker in a the mobile a communication asystems. For a example, bethe cause have present invention is for use in a mobile communication leading a to the contribution of the specific contribution of the contributi such that the Latti-carrier CDMA system including W-CDMA, and a mobile which we have the first extraction and albase station in the mobile communication and albase station in the mobile communication and shows that are a system reoncerned. A telegraph of the constant of the system is a second of the constant of the

According to the present invention, selection of the with the weak $oldsymbol{s}$ base station stransmitting a user data signal with power $oldsymbol{s}$ $oldsymbol{s}$ $oldsymbol{s}$ control is performed based on the quality of the control of the co data signal transmitted with power control similar to that performed against the user data signal. Therefore, as for the user data signal, it is possible to select the base station which can transmit the user data signal with the best quality, and the mobile station can receive the user data of good quality.

Also, according to the present invention,

communication condition in which user data signal is transmitted from one base station selected by the mobile station among a plurality of base stations, updating (switching) from the selected base station can be performed

5 at high speed.

claims.

criterion for selecting the base station transmitting the variable user data signal and a decision criterion sofether transmission power control information are commonized, and selected. The foregoing description of the embodiments is another intended to Timit the invention to the particular details.

The foregoing description of the embodiments is another intended to Timit the invention to the particular details.

All features and advantages of the finvention which falls and within the scope of the invention which falls and within the scope of the invention which falls and within the scope of the invention which falls and within the scope of the invention are covered by the appended

dum gemeinen kontroller i sten et hieren gest vinsken her delig i til kontroller et i sten i der vinske i sten En med est 2000 es es kontroller i sten hieren hieren kontroller i sten i til kontroller i sten kontroller i s I montroller i sten i sten kontroller i sten i s